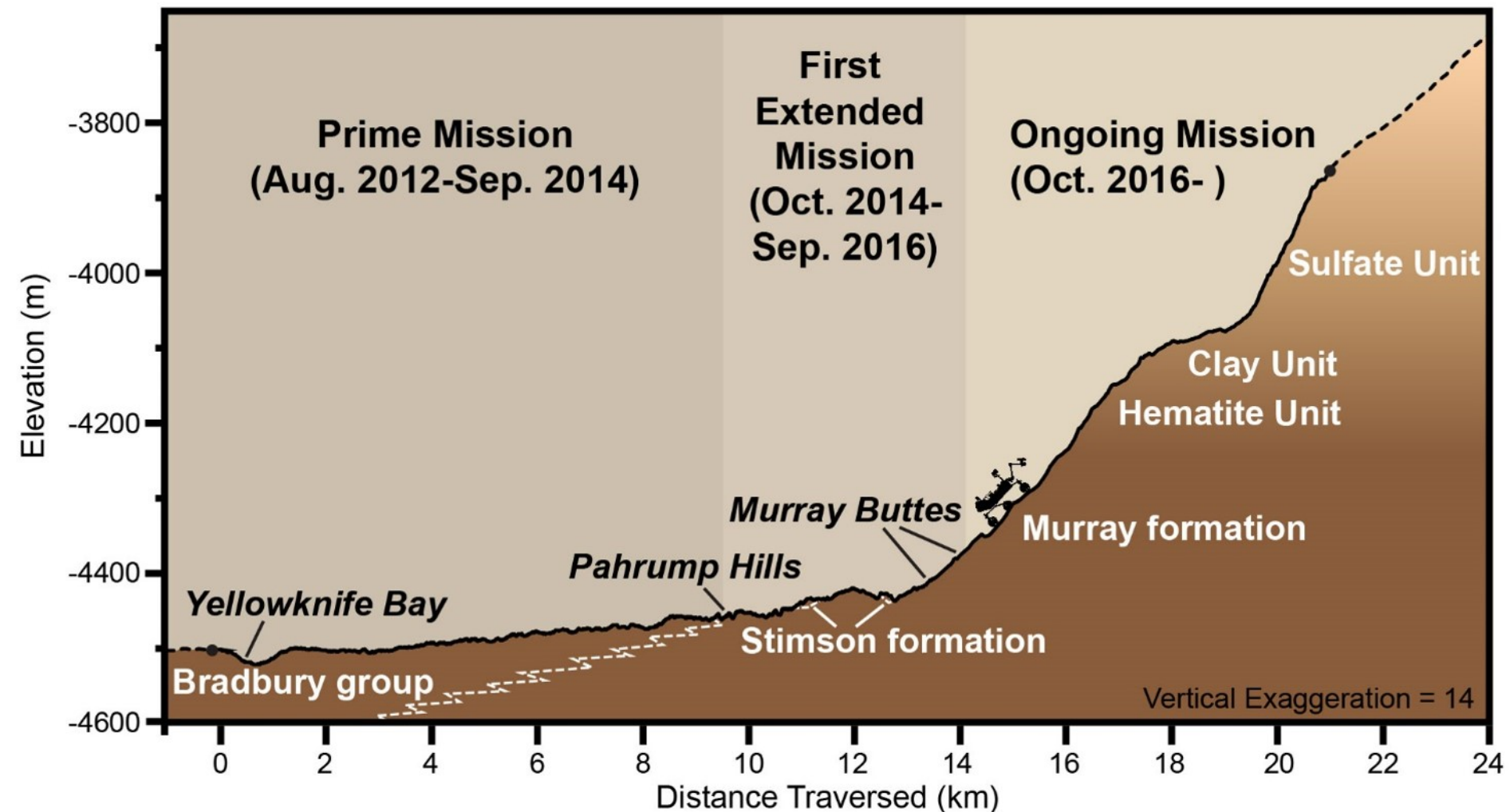
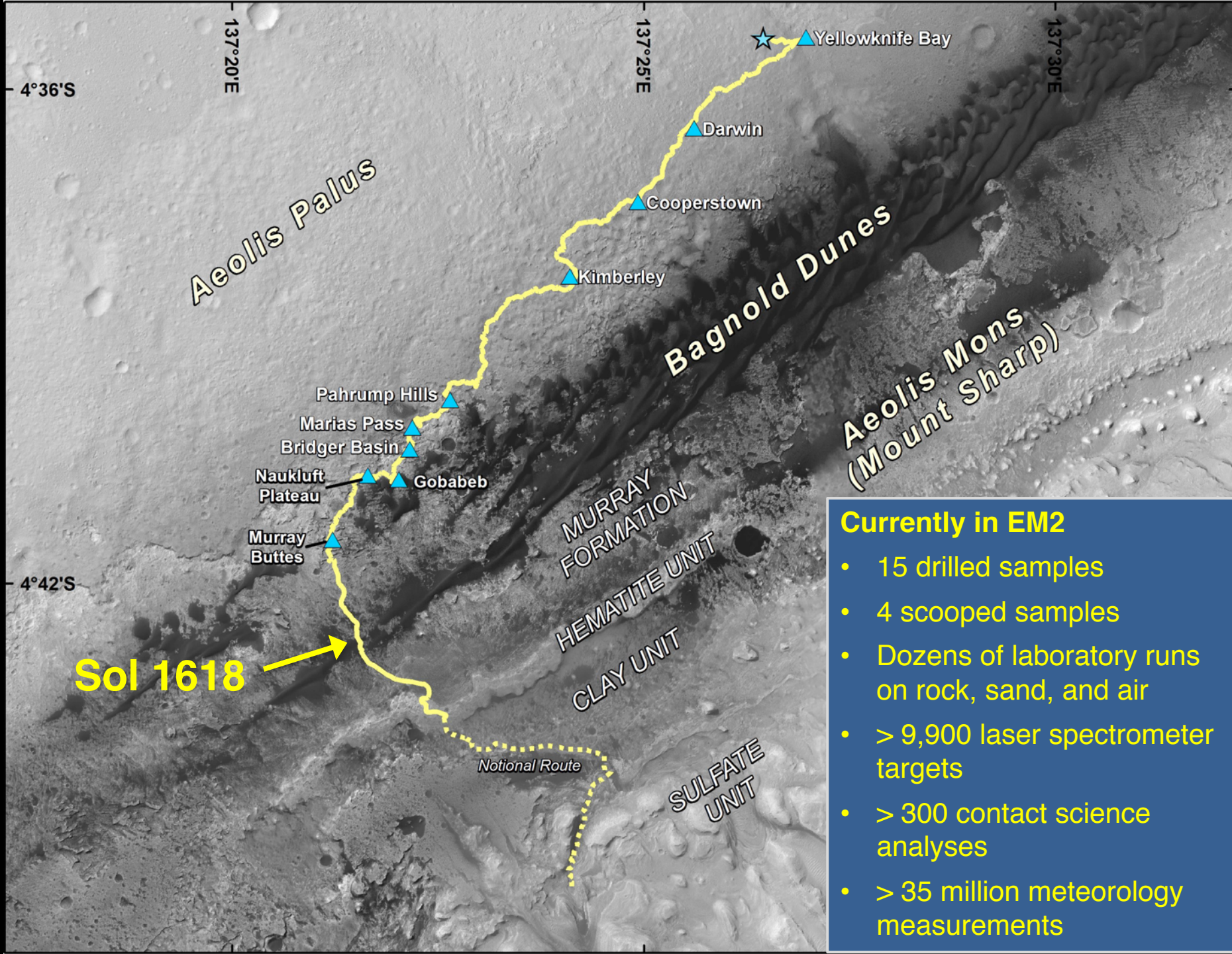


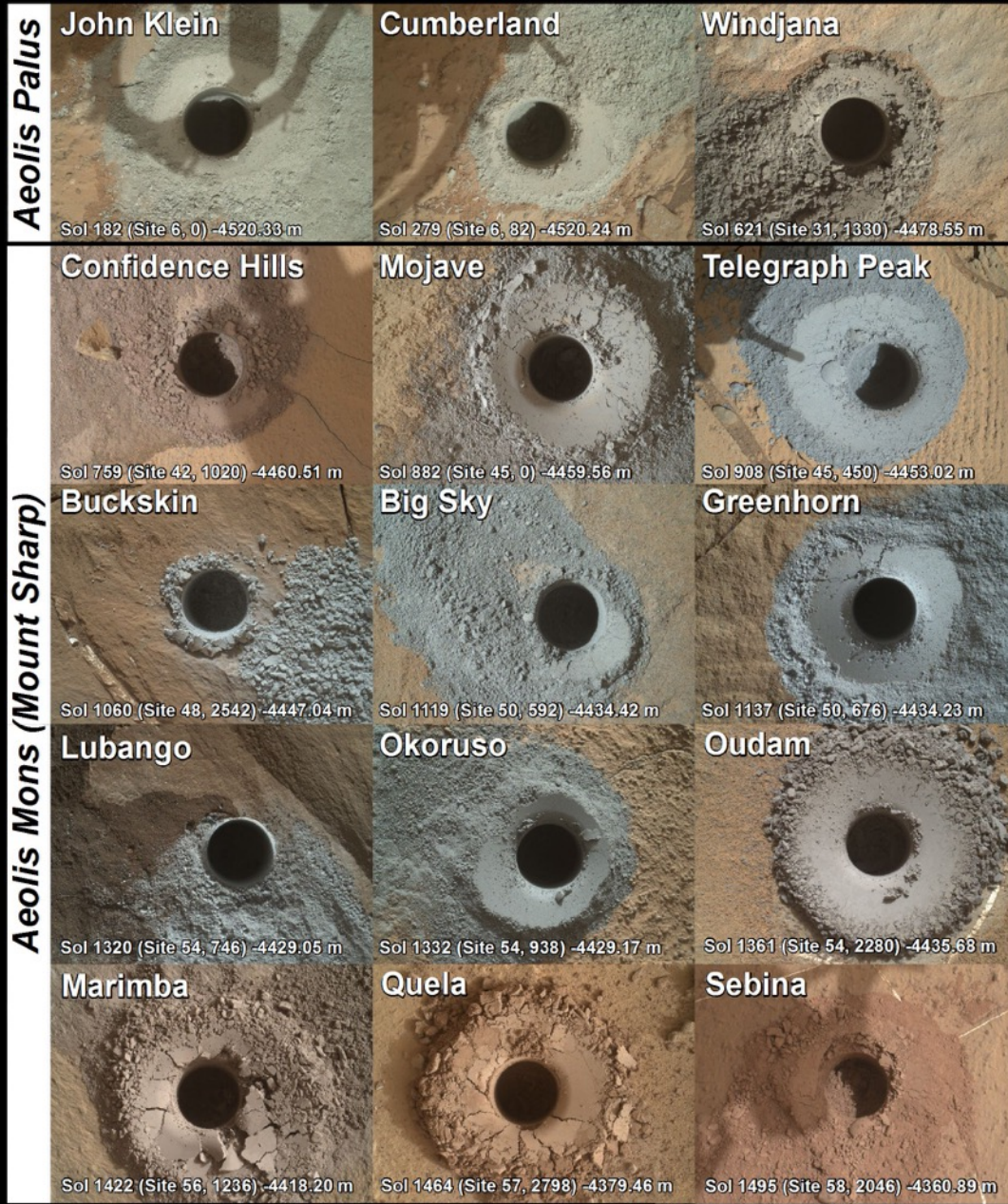
Update from the Mars Science Laboratory

Ashwin R. Vasavada
Project Scientist
Jet Propulsion Laboratory,
California Institute of Technology
MEPAG – February 2017



Odometer = 15.6 km
Elevation = -4300 m (+200 m since landing)



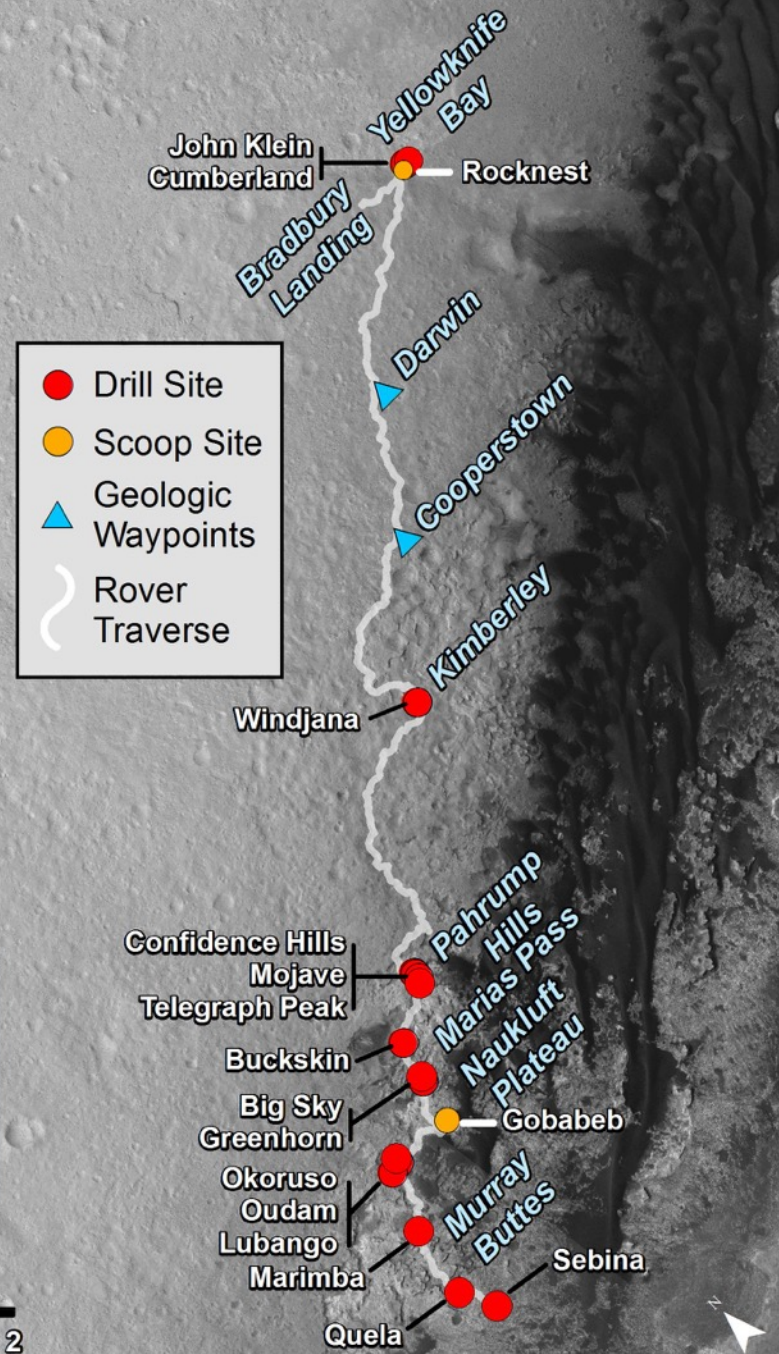


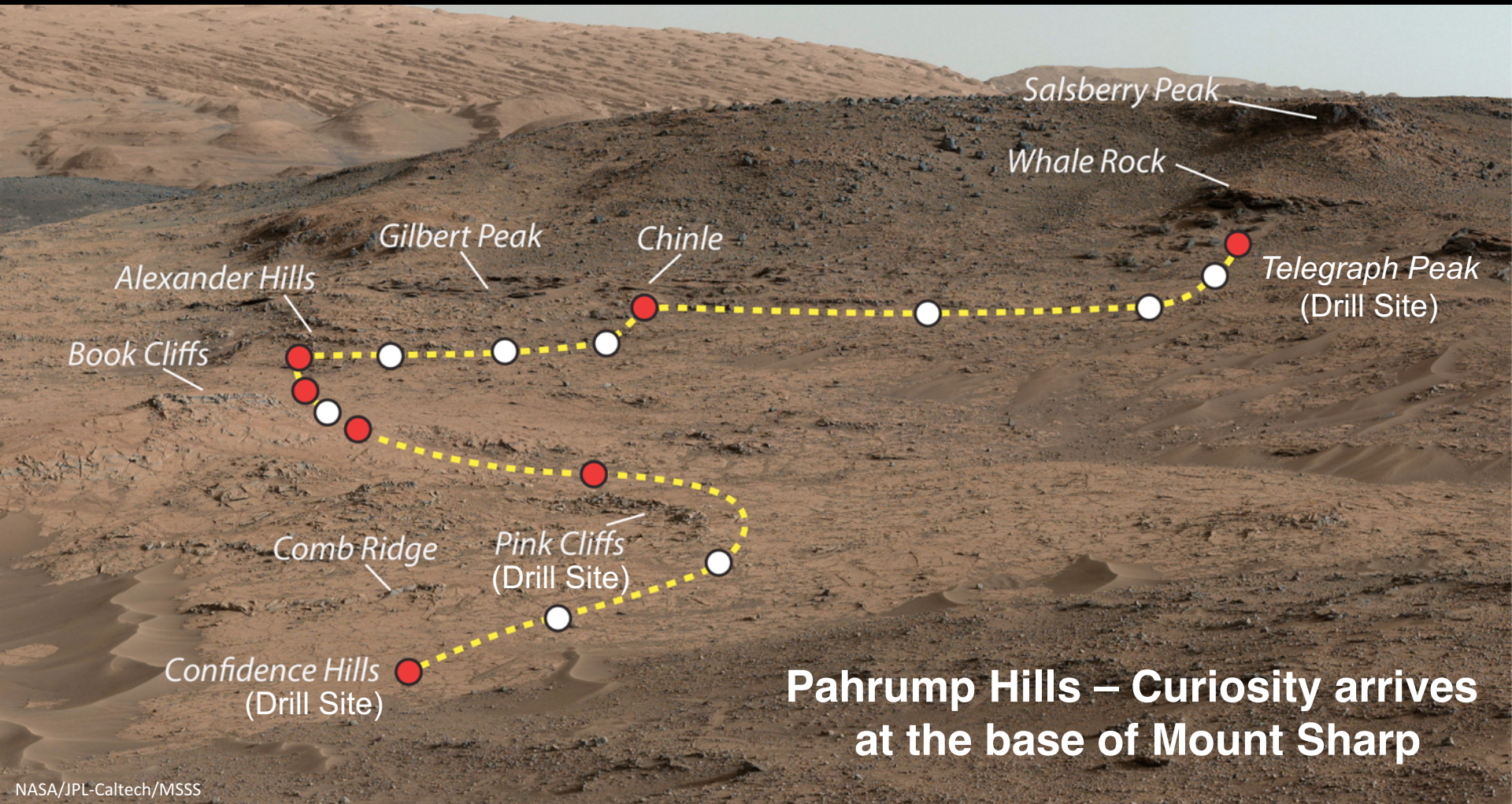
Drill hole diameter = ~1.6 cm.

Map Produced by NASA/JPL-Caltech, 2016
MAHLI and basemap images courtesy
NASA/JPL-Caltech/MSSS/UofA/USGS-Flagstaff

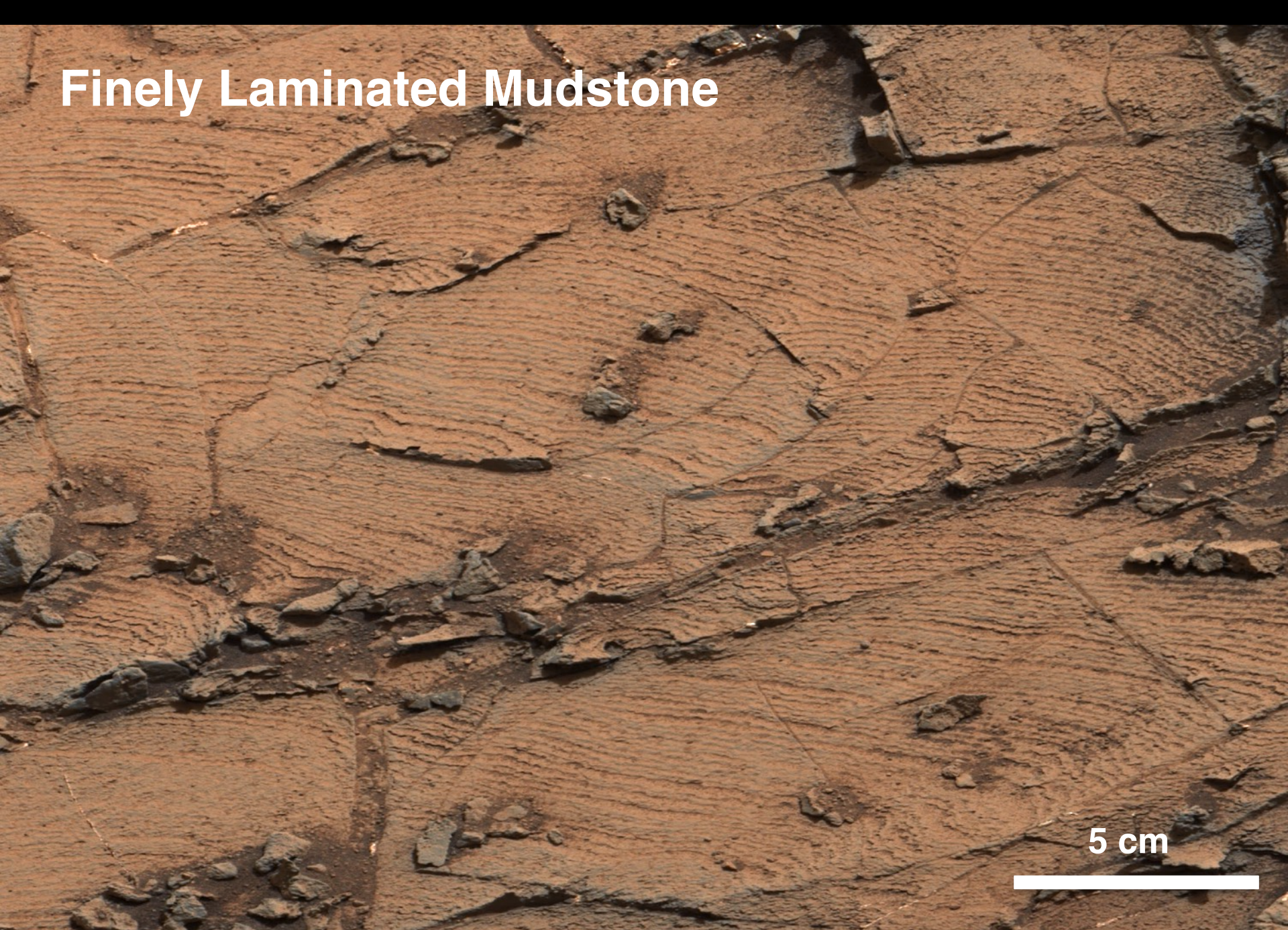
Kilometers
0 0.5 1 2

DRILL SITES AT GALE CRATER



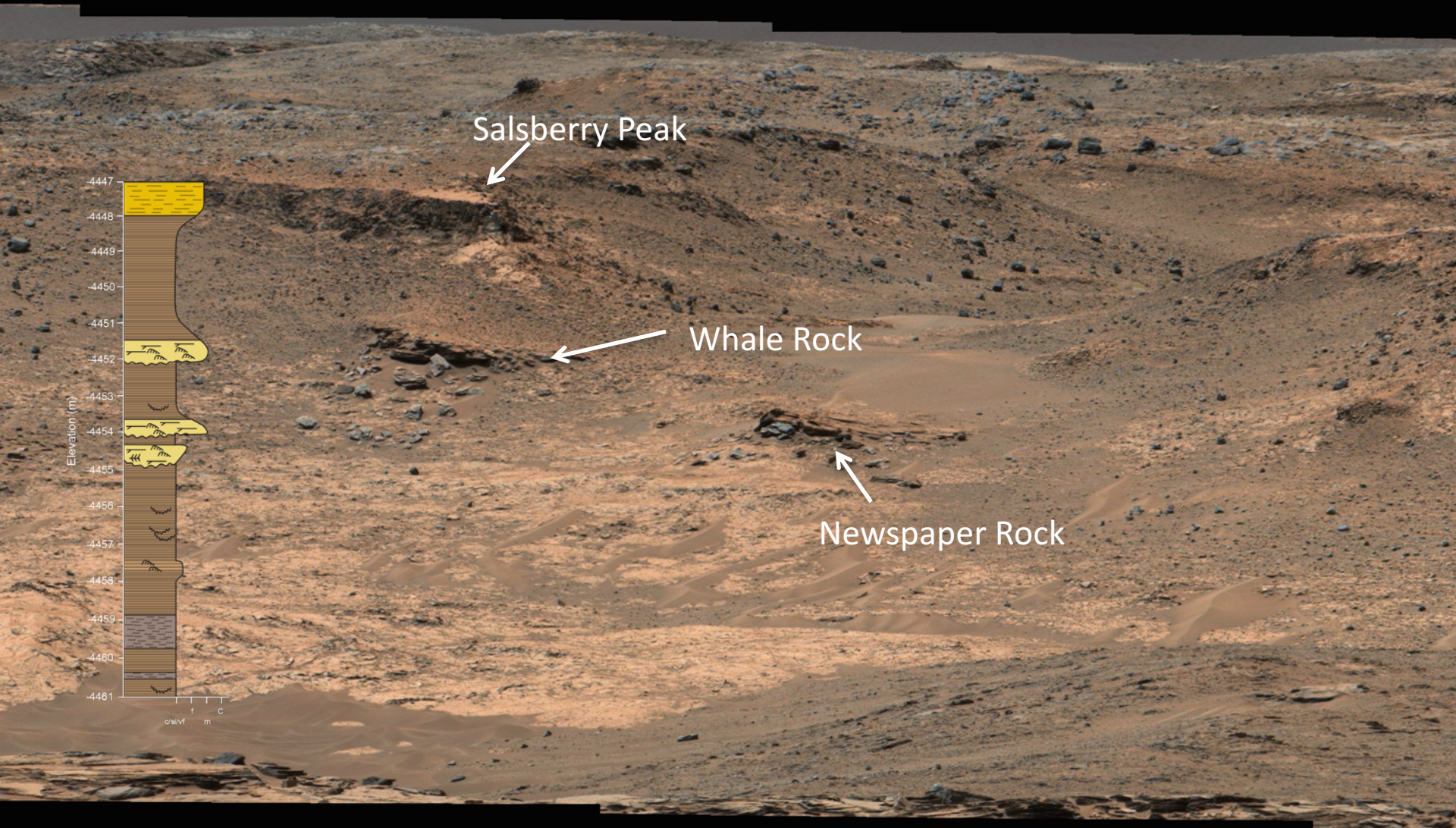


Finely Laminated Mudstone



5 cm

Fine to Coarse-Grained Sandstone Lenses




Pahrump Hills Section

- ~14 m thick sedimentary sequence composed of laminated mudstones with intermittent fine- to coarse-grained sandstone lenses

- Pahrump Hills facies:

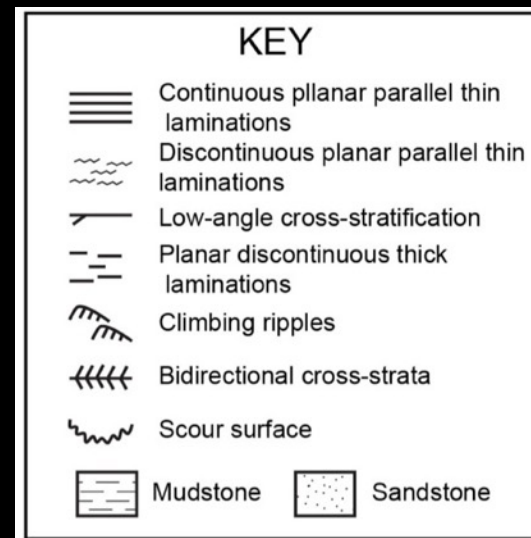
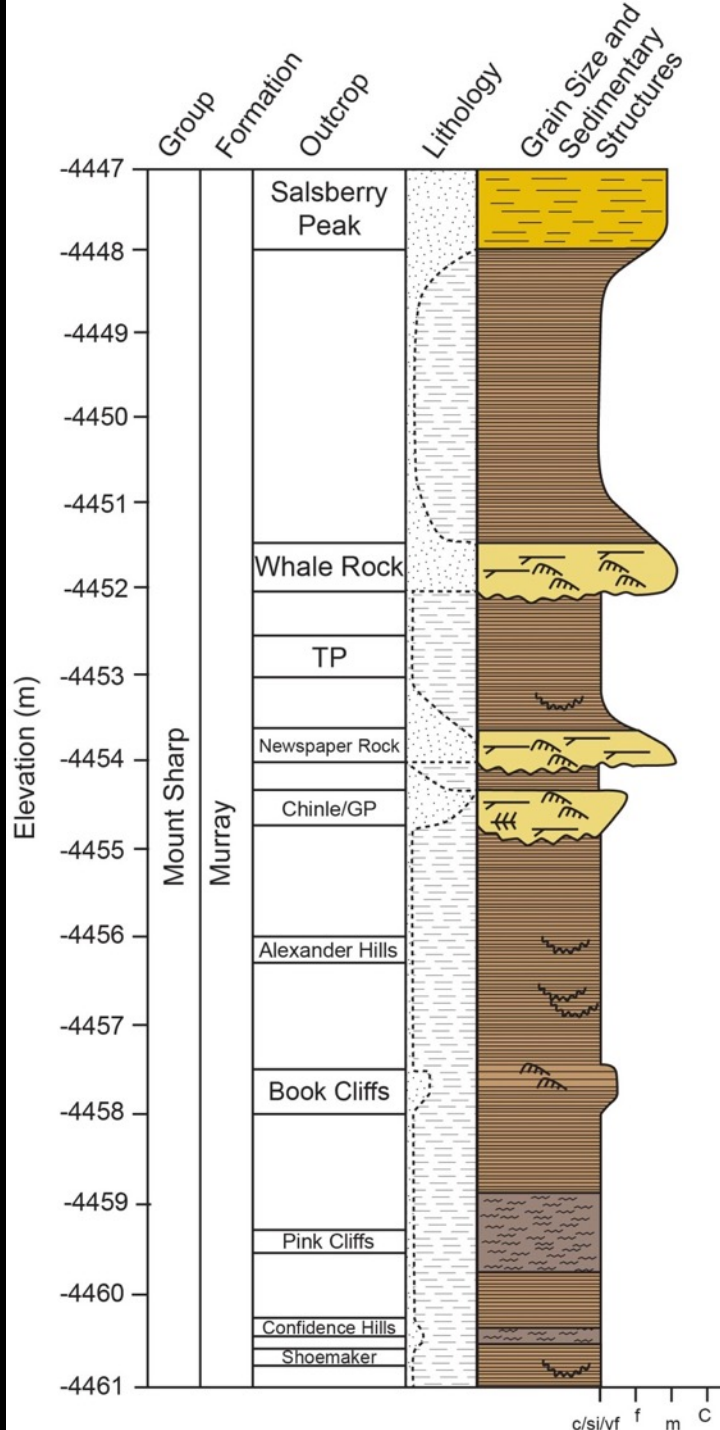
Thin laminated mudstone

 Continuous planar parallel

 Discontinuous planar parallel

 Thick laminated sandstone

 Cross-laminated sandstone



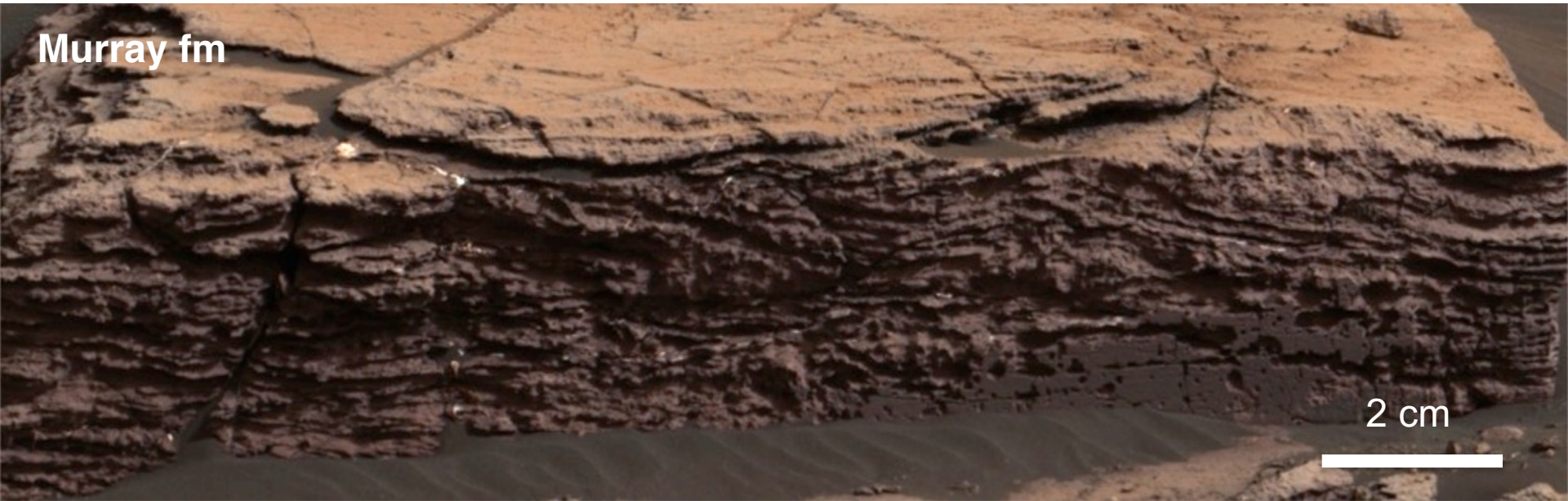
Upper Murray: Trough Cross Stratification



Upper Murray: Cross Laminated (ripples)

Murray fm

2 cm



Triassic Moenkopi

2 cm



Sol 1566
“Old Soaker”



Desiccation Cracks

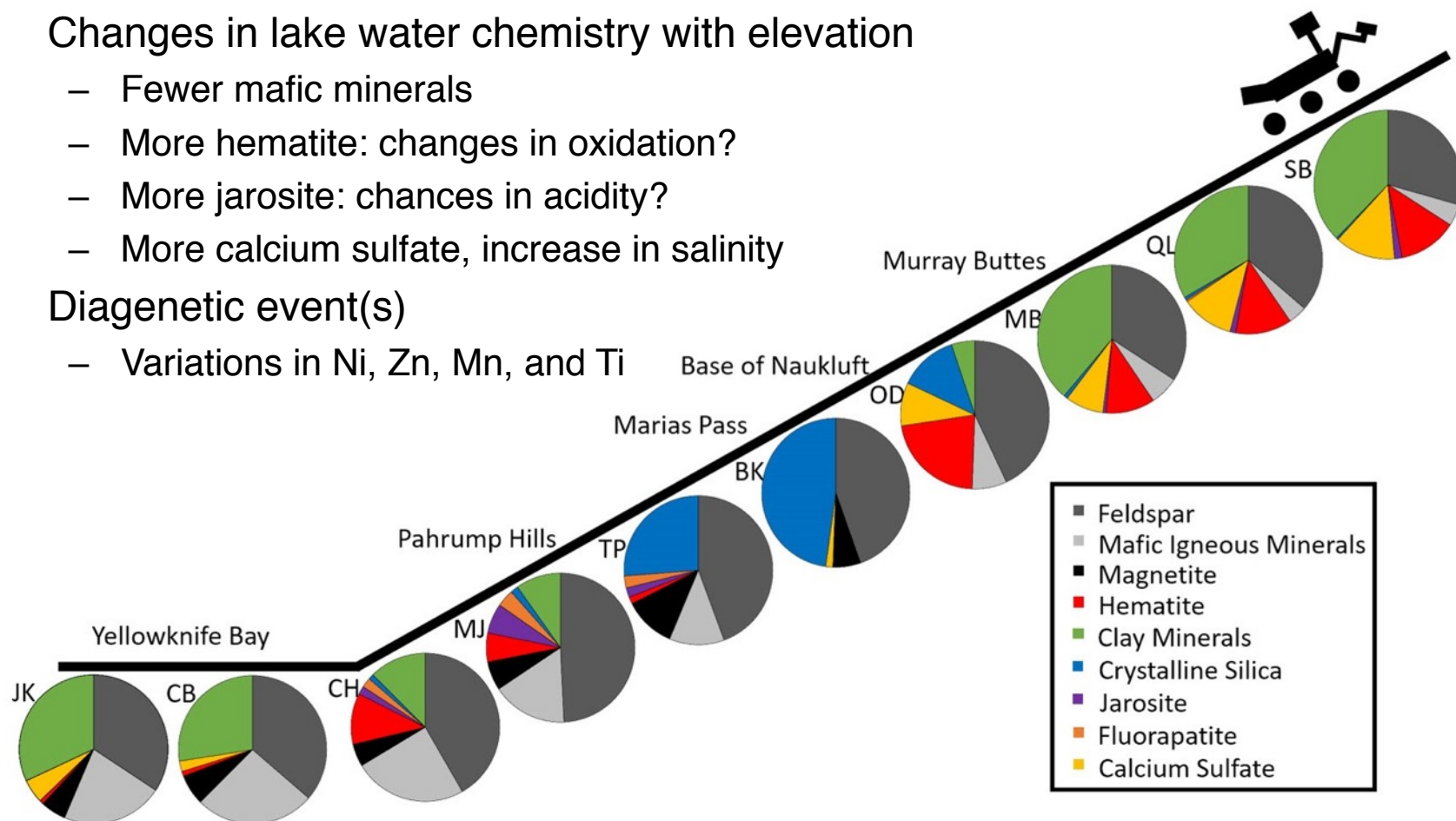
- The surfaces of several blocks show a cm-scale polygonal network of raised, arcuate ridges, comprised of sediment
- The ridge pattern propagates through a red-toned layer but terminates at an underlying, gray layer
- Interpreted as desiccation cracks (now filled ridges) that indicate a single drying event confined to a thin layer

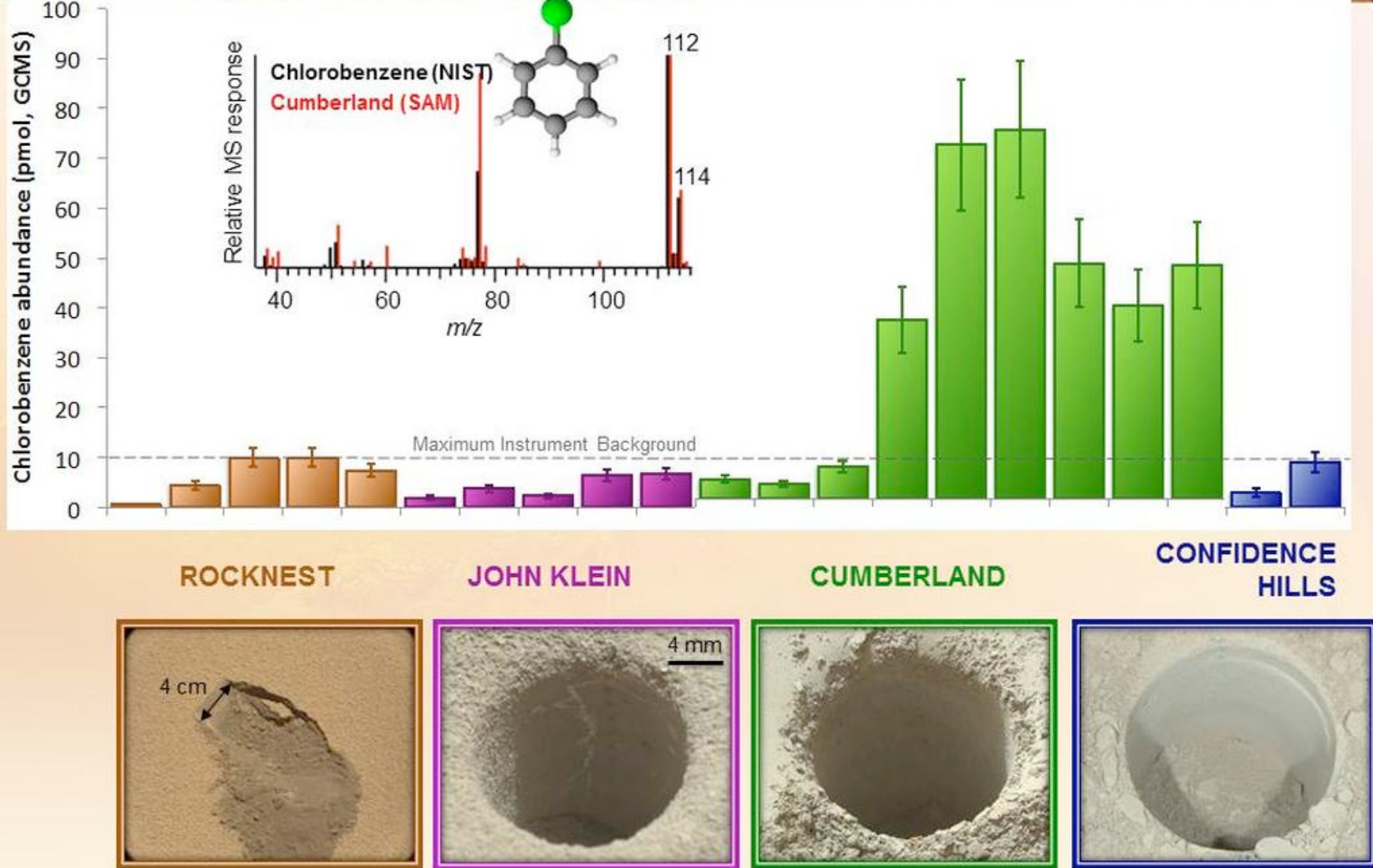
4 cm



Mineralogical Variations in Mudstone Samples

- Changes in clay mineral composition
- Mineralogical differences in source region(s)
 - Crystalline silica, tridymite, and lack of mafic minerals at Marias Pass
- Changes in lake water chemistry with elevation
 - Fewer mafic minerals
 - More hematite: changes in oxidation?
 - More jarosite: chances in acidity?
 - More calcium sulfate, increase in salinity
- Diagenetic event(s)
 - Variations in Ni, Zn, Mn, and Ti



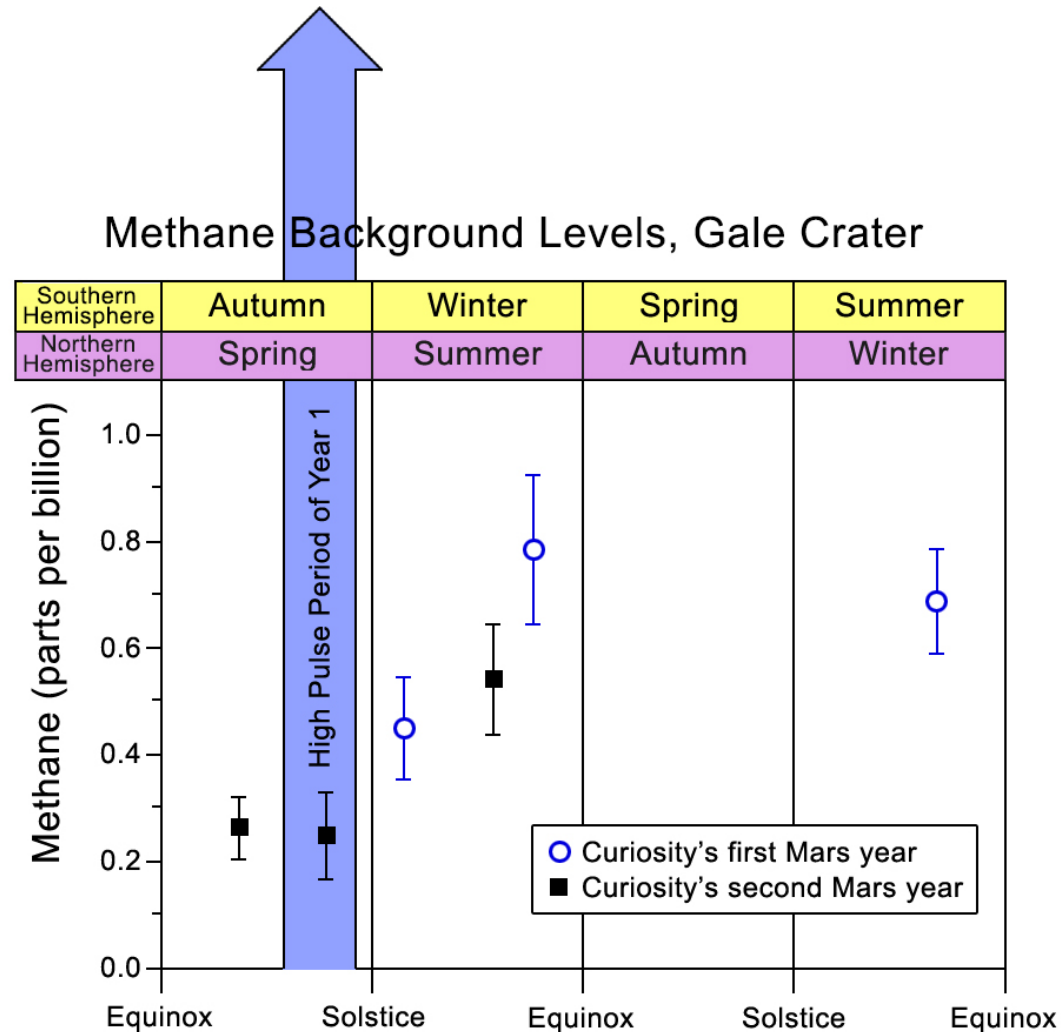


SAM GCMS detected chlorinated organic molecules: chlorobenzene, dichlorobenzene isomers, and dichlorinated alkanes

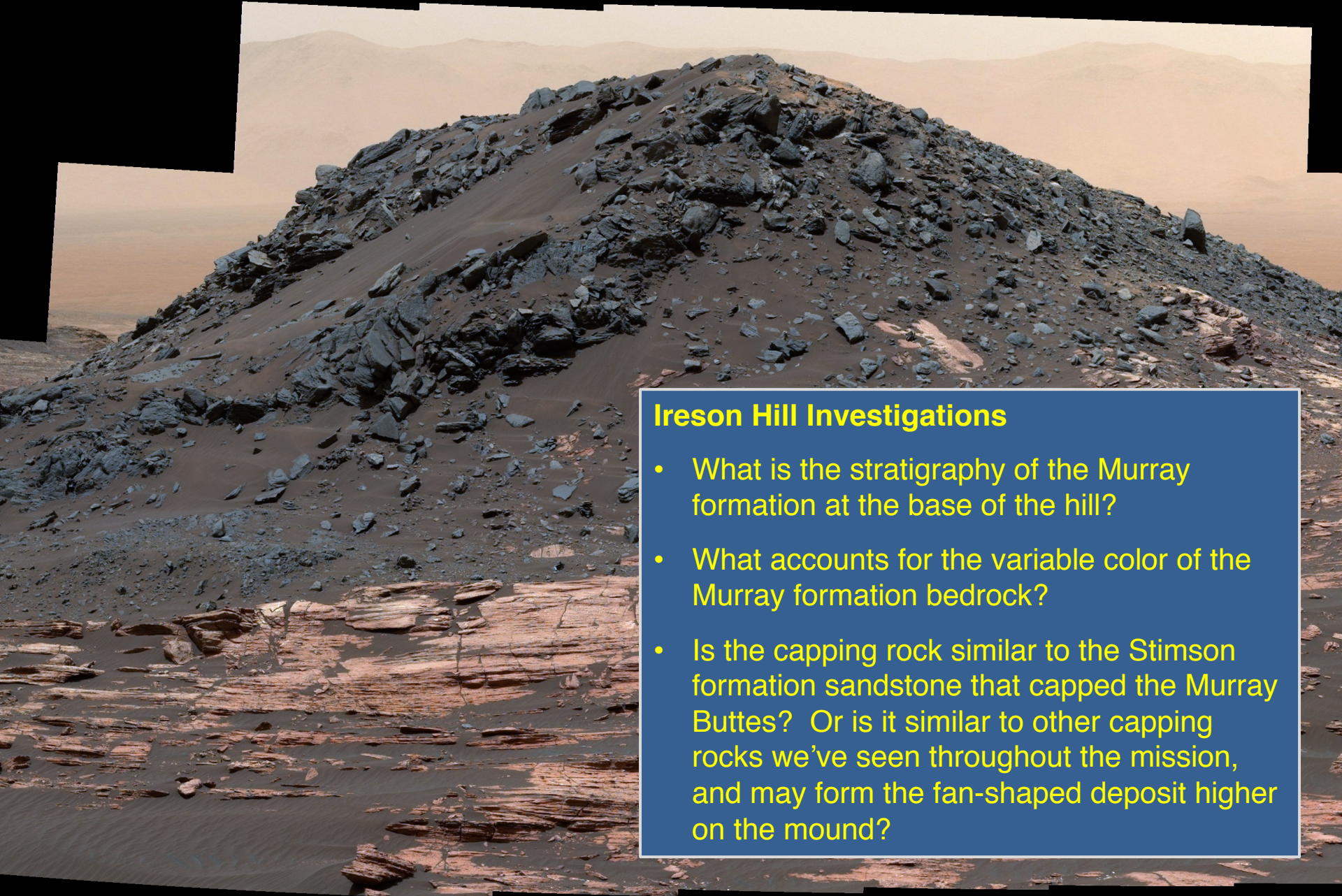
Organic molecules (1-10 ppm C) detected in several lacustrine mudstone samples on the plains and in the bedrock of Mount Sharp

Atmospheric Methane

- Curiosity's tunable laser spectrometer has measured methane for over two Mars years
- A 7-ppbv spike observed over a 60-sol period in the first southern fall has not repeated
- A newer, high-precision technique is revealing a seasonally varying background level of 0.2-0.9 ppbv
- The seasonal variation correlates with UV insolation, not as well with atmospheric mass

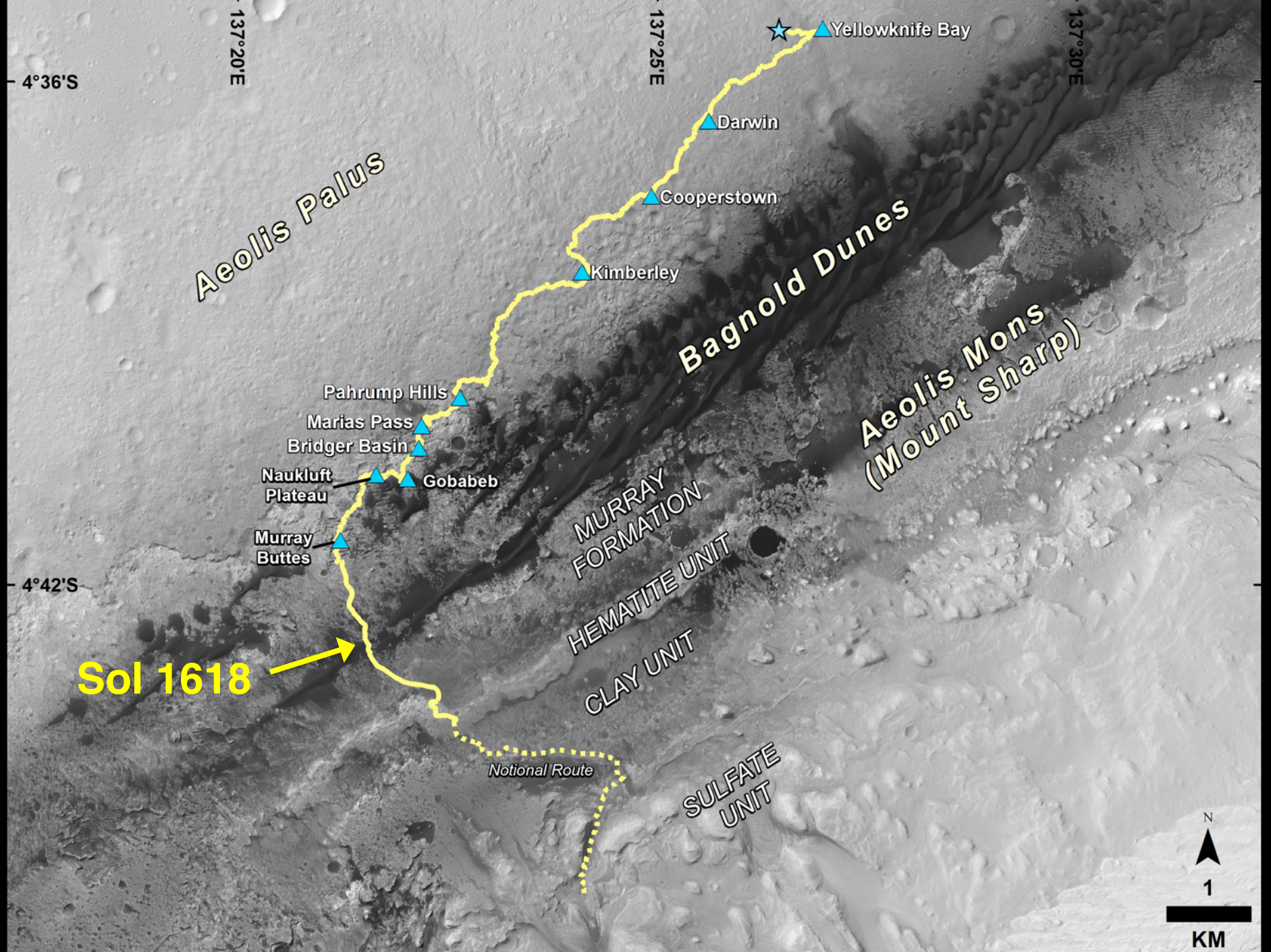


Sol 1598 – Ireson Hill



Ireson Hill Investigations

- What is the stratigraphy of the Murray formation at the base of the hill?
- What accounts for the variable color of the Murray formation bedrock?
- Is the capping rock similar to the Stimson formation sandstone that capped the Murray Buttes? Or is it similar to other capping rocks we've seen throughout the mission, and may form the fan-shaped deposit higher on the mound?



Bagnold Dunes Campaign



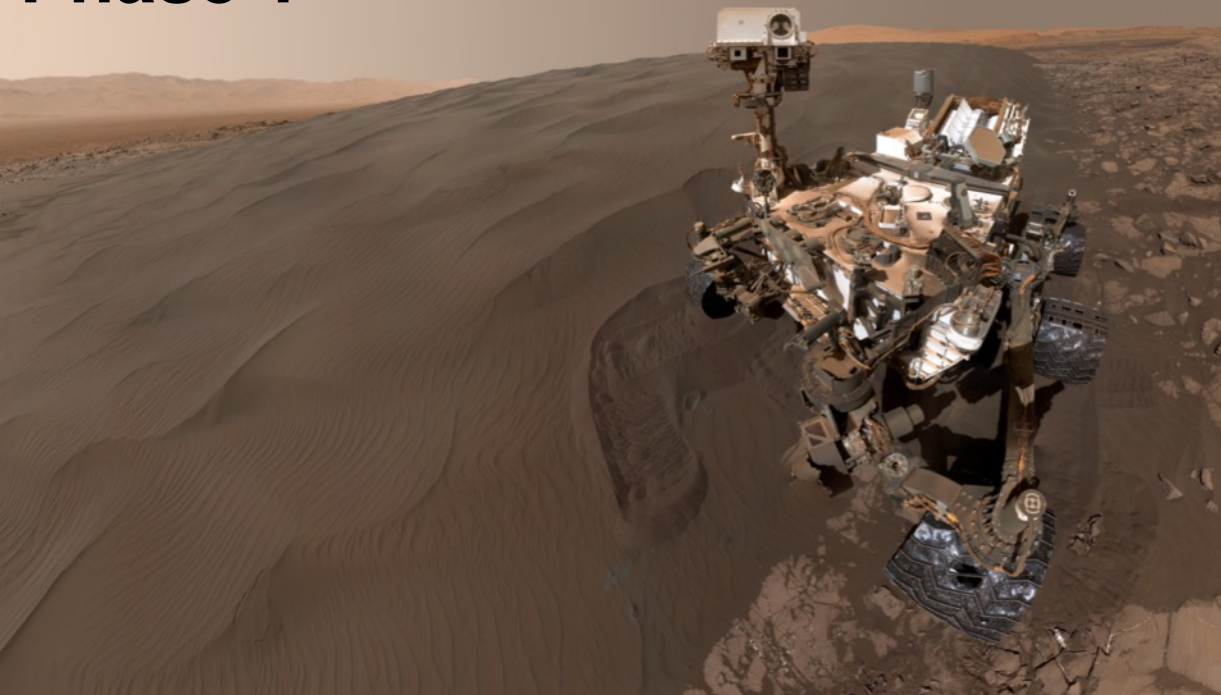
Phase 1



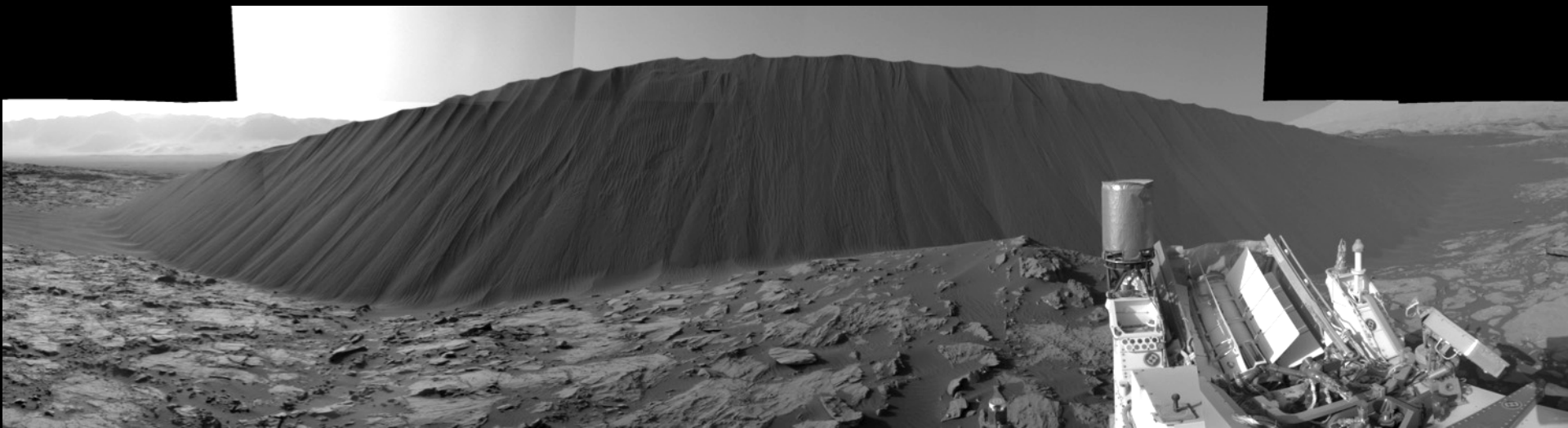
Phase 2

Bagnold Dunes Campaign

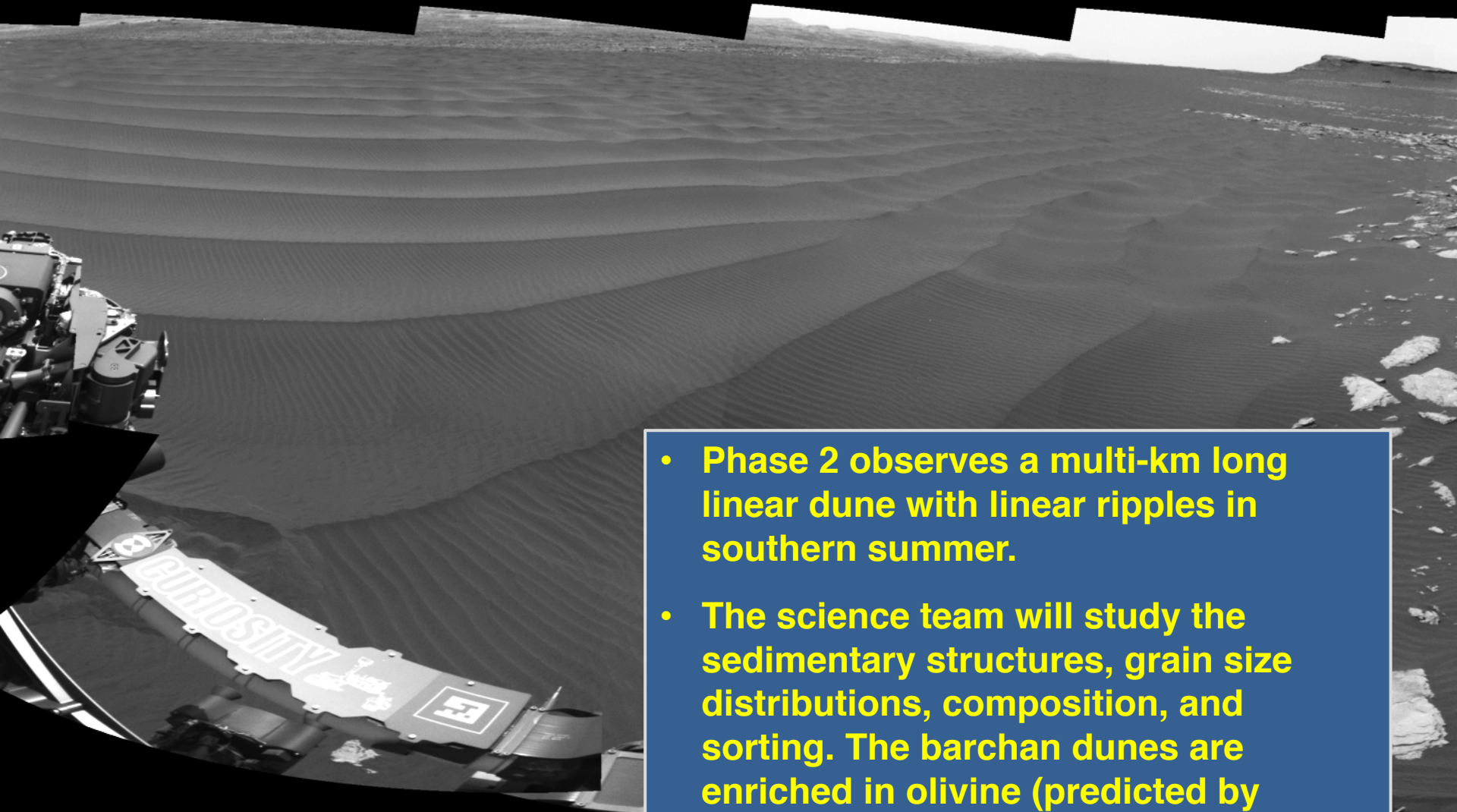
Phase 1



- Phase 1 observed a barchan dune with a slip face in southern winter
- The science team mapped sedimentary structures and their relationship to the measured wind field; identified meter-scale fluid-drag ripples; measured grain size distributions, composition, and sorting



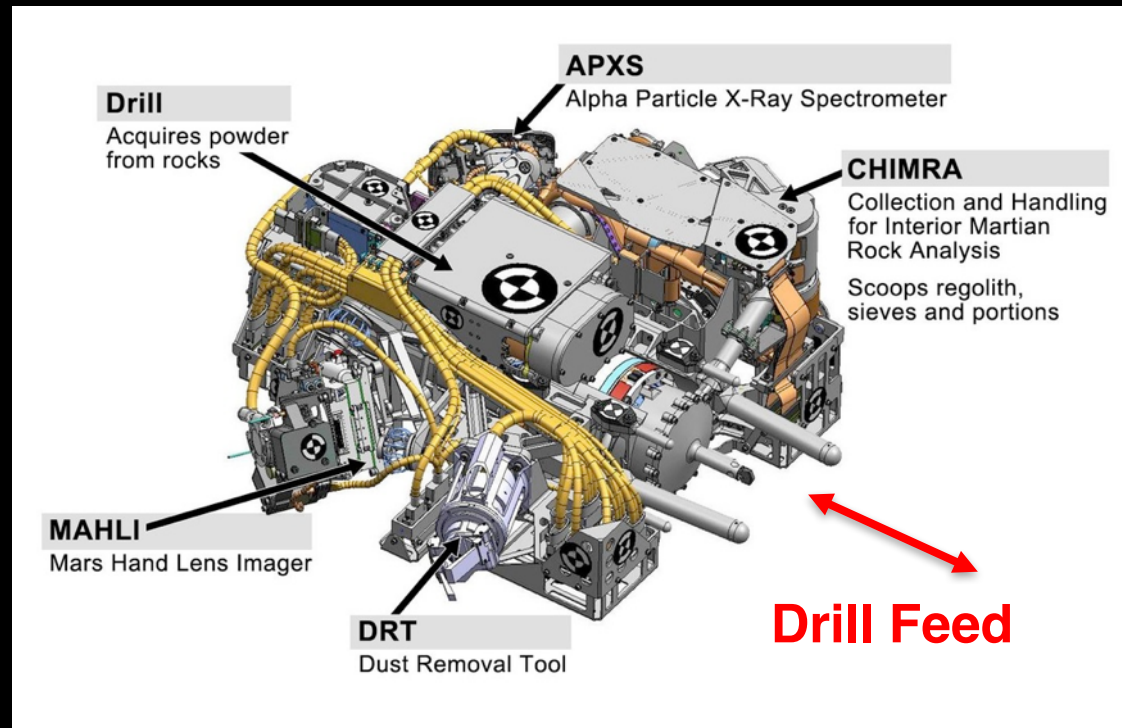
Sol 1601 – Linear Ripples on Bagnold Dunes



- Phase 2 observes a multi-km long linear dune with linear ripples in southern summer.
- The science team will study the sedimentary structures, grain size distributions, composition, and sorting. The barchan dunes are enriched in olivine (predicted by CRISM) while the linear dunes have a stronger high-Ca pyroxene signature.

Drill Feed Anomaly

- The drill feed moves the front end of the drill with respect to the turret and maintains pressure on the drill bit while drilling.
- It currently works intermittently, likely due to the failure of the internal brake to disengage.
- The project is attempting to find a reliable method for disengaging the brake and to return to drilling within a few months.
- If the brake remains unreliable, re-designing the drilling architecture may be necessary, requiring a longer time before returning to drilling.





Summary at 4.5 Years on Mars

- Curiosity is now much of the way through the Murray formation, the thick and enigmatic (from orbit) basal layer of Mount Sharp
- The depositional environments recorded in the Murray are primarily lacustrine but there is growing evidence for intermittent fluvial and aeolian activity
- As a whole, the Murray formation has recorded a nearly continuous record of habitable environments, though variable, spanning at least tens of millions of years
- Water was present significantly longer than that, given the evidence for multiple generations of diagenesis spanning multiple cycles of burial and exhumation
- Organic molecules have been found more often than not in Murray formation, indicating their prevalence and preservation. Their origin and means of preservation are becoming clearer.
- Curiosity also continues to make progress in EM2 understanding the geological evolution of Gale crater, atmospheric evolution, modern meteorology and surface processes, atmospheric chemistry, high-energy radiation.